

3600.3245  
June 13, 2002 (11:47AM)



Docket: AM-3245

RECEIVED  
JUN 19 2002  
TECHNOLOGY CENTER 1700

### REMARKS

Claims 1, 2, 12-14, 16 and 21-45 remain in the application.

The title has been amended to conform to the broadened claims.

The Examiner has rejected Claims 1, 2, 12-14, 16, 21-29, 31, and 33 under et USC §102(e) as being anticipated by US Patent 6,174,451 to Hung et al. (hereinafter, Hung).

The Examiner has rejected Claims 21-27 under 35 USC §102(e) as being anticipated by US Patent 6,211,092 to Tang et al. (hereinafter, Tang).

The Examiner has rejected Claims 30 and 32 under 35 USC §103(a) as being obvious over Hung and in view of US Patent 6,069,092 to Imai et al. (hereinafter, Imai).

All these rejections depend in whole or in part upon either Hung or Imai. Both these references were commonly assigned with the present application by Applied Materials, Inc. The assignments for the present application were recorded on July 19, 1999 at Reel 10099, Frame 0163 and at Reel 10099, Frame 0166. The assignment for US Patent 6,174,451 (Applied Docket 2073.P3) was recorded on November 16, 1998 at Reel 9598, Frame 0751. The assignment for US Patent 6,211,092 (Applied Docket 2838) was recorded on December 1, 2000 at Reel 011373, Frame 0968.

The CPA of this case is entitled to the benefits of the American Inventors Protection Act of 1999, in particular the provisions of 35 USC §103(c) according to which commonly assigned §102(e) references do not preclude patentability.

Accordingly, all the rejections should be removed, and all the claims should be held allowable.

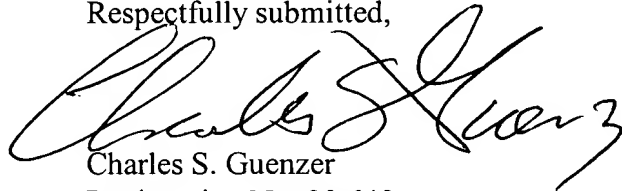
New dependent claims either specify the fluorocarbon to be  $C_5F_8$  or particularize the etched structure to structures such as dual damascene.

The chemicals in Claim 27 have been broadened to include isomers while avoiding nomenclature problems with  $C_5F_8$ . A minor amendment to Claim 21 permits ready distinction of the two different types of holes in new Claim 36.

A new set of Claims 37-45 emphasizes the dual damascene process not requiring a middle stop layer, as exemplified by the described timed dual damascene etch.

In view of the above amendments and remarks, reconsideration and allowance of all claims are respectfully requested. If the Examiner believes that a telephone interview would be helpful, he is invited to contact the undersigned attorney at the listed telephone number, which is on California time.

Respectfully submitted,



Charles S. Guenzer  
Registration No. 30,640  
(650) 566-8040

Date: 13 June 2002

Correspondence Address  
Patent Counsel  
Applied Materials, Inc.  
P.O. Box 450A  
Santa Clara, CA 95052

D

Serial No. 09/276,376

Version with markings to show changes made

**In the title:**

**Please change the title to:**

Enhancement of Silicon Oxide Etch Rate and Nitride Selectivity Using Hexafluorobutadiene or Other Heavy Perfluorocarbon

**In the claims:**

21. (Twice Amended) A process for etching an oxide layer preformed with first holes extending downwardly from a top surface thereof, comprising the steps of:

flowing into a plasma reaction chamber a gas mixture comprising a first amount of a fluorine-containing gas and a second amount of a chemically inactive diluent gas, wherein a ratio of said second amount to said first amount is at least one;

applying a first level of RF power to a pedestal electrode supporting a substrate containing said oxide and non-oxide layer; and

exciting said gas mixture into a plasma to etch said oxide layer, wherein corners of said oxide layer at tops of said first holes are exposed during the process.

27. (Twice Amended) The process of Claim 25, wherein said fluorocarbon is selected from the group consisting of  $C_4F_6$ ,  $C_3F_8$ , and  $C_6F_6$  [hexafluorobutadiene, hexafluorocyclobutene, hexafluorobenzene, octafluorocyclobutane, and octofluoropentadiene].

34. (New) The process of Claim 27, wherein said fluorocarbon comprises  $C_3F_8$ .

35. (New) The process of Claim 21, wherein said oxide layer is precoated with an etching mask having an aperture larger than and surrounding at least one of said first holes.

36. (New) The process of Claim 21,

wherein said exciting step etches second holes in said oxide layer, and  
wherein said first holes form via holes and said second holes form trenches in a dual damascene interconnect system.

37. (New) A dual damascene process for etching an oxide layer preformed with first holes extending downwardly from a top surface thereof and covered by a mask layer including a second hole therethrough larger than and surrounding at least one of said first holes, comprising the steps of:

flowing into a plasma reaction chamber a gas mixture comprising (a) a fluorocarbon selected from the group consisting of  $C_4F_6$ ,  $C_5F_8$ , and  $C_6F_6$  and (b) a chemically inactive diluent gas; and

applying RF power to a pedestal electrode supporting a substrate containing said oxide layer and exciting said gas mixture into a plasma to etch said oxide layer, wherein corners of said oxide layer at tops of said first holes are exposed during the process.

38. (New) The process of Claim 37, wherein a portion of a top surface of said oxide layer is exposed by said second hole.

39. (New) The process of Claim 37, wherein a nitride layer is disposed below said oxide layer and is exposed by said first holes.

40. (New) The process of Claim 39, wherein no other nitride layer is disposed between a top surface of said oxide layer and said nitride layer.

41. (New) The process of Claim 37, wherein said fluorocarbon comprises hexafluorobutadiene.

42. (New) The process of Claim 37, wherein said fluorocarbon comprises  $C_3F_8$ .

43. (New) The process of Claim 37, wherein a separate source of oscillatory electrical power excites said gas mixture to said plasma.

44. (New) The process of Claim 37, wherein said RF power applied to said pedestal electrode excites said gas mixture to said plasma, no other effective source of oscillatory electrical power being applied to said plasma reaction chamber.

45. (New) The process of Claim 37, wherein said applying and exciting step is terminated before portions of said oxide layer exposed by said second hole are etched through.